DRINKING WATER QUALITY ISSUES FOR DELTA SOURCE WATERS

ISSUE PAPER

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Briefing Paper for
Bay Delta Oversight Council
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Summary

Bay Delta Oversight Council has prepared an extensive briefing paper on general Drinking Water Quality Issues for Delta Water Sources. They have invited CCWD to provide a brief issue paper on existing and future impacts and concerns that are specific to CCWD's use of Delta water as a source of supply for drinking water.

As discussed in the following pages, the use of Delta water as a drinking water source continues to present significant challenges to CCWD. The cost of source water protection and treatment is expected to increase dramatically over the next decade as environmental and drinking water regulations become more and more stringent.

Background

Contra Costa Water District is a public agency responsible for providing the drinking water supply to approximately 400,000 people within central and eastern Contra Costa County. CCWD treats and distributes drinking water to 200,000 people. The remainder receive their drinking water from city and investor owned treatment and distribution facilities. Essentially all of CCWD's water supply is directly diverted from the Delta. In normal years CCWD is entitled divert up to 195,000 acre feet (AF) at Rock Slough under its CVP contract and up to 27,000 AF at Mallard Slough (when water quality permits) under its appropriative water rights. In addition several industries and the City of Antioch hold their own water rights for direct Delta diversions. Current water usage within CCWD is about 130,000 AF per year in non-critical years.

The District currently operates two treatment facilities. The Bollman Plant is a conventional 75 million gallons per day (mgd) plant employing coagulation-flocculation-sedimentation-filtration processes. Chlorine is used for primary disinfection and chloramine as a residual disinfectant in the distribution system. The Randall-Bold Plant is a new 40 mgd state-of-the-art treatment facility employing coagulation-flocculation-direct deep bed GAC filtration. Ozone is used as a preoxidant and for primary disinfection with chloramine as the residual disinfectant in the distribution system.

CCWD Issues Related to Delta Water Quality

CCWD's long-standing concerns with Delta water quality include: water quality variability; particulate loading; microbiological pathogens; THM precursors (total organic carbon and bromides); taste and odor; and nutrient loading (nitrogen and phosphorous).

Water Quality Variability: CCWD diverts directly from the Delta and does not have storage facilities to dampen out the significant water quality fluctuations that occur. For example, during the course of a year chloride levels can range from 30 mg/l to 250 mg/l, temperatures from under 10°C to over 20°C, and TOC from 2 mg/l to10 mg/l.

Many of these changes can take place over just a few days. Such wide fluctuations cause consumers to voice their concerns each time the water tastes "different" and requires that treatment plants be capable of responding quickly and effectively in order to maintain compliance with regulatory standards.

Particulate Loading and Pathogens: Turbidity is a measurement of the clarity of the water. Higher turbidities indicate more particulate matter in the water. The particles include both sediments and microbiological pathogens such as bacteria, viruses, protozoa cysts, etc. Full conventional treatment (or comparable) is normally required for treatment of Delta water supplies to effectively remove the sediment loading and to eliminate pathogenic microorganisms. Conventional treatment is made up of coagulation, flocculation, sedimentation, filtration and disinfection processes. Department of Health Services will approve alternative technologies, such as CCWD's Randall Bold WTP, if performance is demonstrated to be comparable to or greater than conventional plants.

THM precursors: Trihalomethanes (THMs) are produced by the interaction of total organic carbon (TOC), bromide and chlorine. TOC and bromides are the THM precursor materials naturally present in the raw water while chlorine is added at the treatment plant to achieve disinfection. Bromide levels increase during low Delta outflow periods as a result of sea water intrusion. TOC levels can increase as a result of runoff from organic rich soils, die-off of algae or vegetation growing within the water, etc. If disinfection effectiveness is to remain consistent, the level of THMs produced will increase as the level of precursors increase.

Taste and Odor - a salty taste is imparted to CCWD's drinking water whenever chloride levels go above the 100-150 mg/l range. Conventional treatment does not reduce salinity. Consumers complaints normally accompany such seasonal increases in salinity within CCWD. Taste and odors associated with biological activities ie. algae, decaying vegetation, etc. occur sporadically and were historically treated by oxidation with chlorine and more recently by adsorption onto activated carbon.

Nutrient loading - nitrogen and phosphorous loading in delta supply are sufficient to promote biological growths in the delta itself, the Contra Costa Canal, and treatment plant forebays. Growths not only induce taste and odor problems as discussed above but can impact treatment plant performance by clogging filters, screens, etc. Chemicals used to control these growths, such as copper sulfate, are coming under increasing scrutiny due to potential impacts on the aquatic environment.

Impacts of Recent Regulation

During last few years CCWD modified its Bollman Treatment Plant operations in response to new regulations and the extended drought. Bromide levels remained high during much of the year due to low outflows and resulted in higher THM levels. At the same time the new Surface Water Treatment Rule (SWTR) went into effect setting more stringent disinfection requirements. Treatment processes were modified to maximize disinfection effectiveness, minimize THM formation, and provide alternative methods for control of taste and odors. Modifications included expanded pH control capabilities, elimination of chlorine use as an oxidant for taste and odor control and as coagulant aid, installation of granulated active carbon (GAC) as filter media and switching to post-filtration disinfection with chlorine. Regulatory compliance was thereby maintained under the new Surface Water Treatment Rule without increasing THMs. However, capital cost of the modifications were over $ 2 million, and annual operating costs have increased about $ 200,000 - $300,000.

Impacts of Future Regulations

In compliance with the Safe Drinking Water Act of 1986, EPA will be releasing the draft Disinfection/Disinfection By-Product Rule (D/DBP) in the latter half of 1993 and will be promulgating the final Rule in 1995. Preliminary indications are that impacts on CCWD will initially be limited to: 1) modification of the coagulation process at Bollman; 2) expansion of CCWD's raw water monitoring program to include additional unregulated microbiological contaminants; and 3) performing bench/pilot studies on Total Organic Carbon (TOC) removal technologies. The cost impact on CCWD's annual operating costs could be around $400,000. The potential pilot studies represent a one time cost of $30,000 - $300,000.

Elements of the rule that potentially impact CCWD because the Delta is the source of supply are:

Parameter	Tentative Requirement
Total Trihalomethanes (TTHMs)	MCL of 80 µg/l
Total Haloacetic Acids (THAAs)	MCL of 60 µg/l
Bromate	MCL between 5 and 15 µg/l
Total Organic Carbon (TOC)	Action Levels of 2 µg/l and 4 µg/l
Monitoring of unregulated constituents	Giardia, Cryptosporidium, total and fecal coliforms

THMs are DBPs primarily associated with the use of chlorine and directly relate to the amount of TOC and bromide in the source water. TTHM standard of 80 µg/l should not present a problem to CCWD for either of its treatment plants. Randall Bold consistently produces TTHMs under 10 µg/l because it does not normally use free chlorine. Bollman uses free chlorine for primary disinfection and has historical TTHM levels approaching 100 µg/l. However, since Bollman operations were modified in 1991, in response to the drought and the Surface Water Treatment Rule (SWTR), it has been able to keep THMs in the range of 50 - 80 µg/l. These levels may drop slightly if enhanced coagulation for TOC removal is implemented at Bollman (due to the lower pH that would result from the enhanced coagulation).

HAAs are DBPs primarily associated with the use of chlorine and directly relate to the amount of TOC and bromide in the source water. THAAs have not previously been regulated, therefore CCWD does not have as much data on HAAs as it does for THMs. However, it would appear at this time that both treatment plants should be able to stay below the proposed 60 µg/l standard. Since free chlorine is not used at Randall Bold, HAAs should be minimal. Preliminary tests of the Bollman process range from 20 - 50 µg/l. However, implementation of enhanced coagulation at Bollman may increase the HAA levels (due to the lower pH that would result from enhanced coagulation). This will need to be addressed as part of any conversion to enhanced coagulation.

Bromate is a DBP of ozonation and therefore is only produced at Randall Bold. The amount of bromate produced is highly dependent upon the amount of bromide present

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in the raw water (which in turn is directly related to the salinity of the water). It is projected that a bromate MCL of 15 μg/l could be met at most times. However, meeting a bromate MCL in the 5-10 μg/l range may be difficult during periods of low Delta outflow (when chlorides are in the 100-200 range). Current research is looking at process modifications that may reduce the amount of bromate during ozonation. Process modifications that appear promising include: pH adjustment; ammonia addition; and contactor operation (ie. lower ozone residual in conjunction with longer contact time). A bromate MCL lower than 5 μg/l could significantly limit the usefulness of ozone on Delta water.

TOC is not a DBP. It is primarily made up of naturally occurring organic substances in the water that react with the disinfectant to produce many of the DBPs. TOC is typically referred to as a DBP precursor. TOC itself presents no known health risks. It is the DBPs that are formed that are believed to have public health impacts. EPA and environmentalists have suggested it is necessary to regulate the levels of TOC to minimize the health impacts of both the known and yet to be identified DBPs. TOC action levels have been proposed at 4 mg/l and 2 mg/l. Conventional water treatment systems with TOC greater than 2 mg/l would be required to implement enhanced coagulation for TOC removal. After initiation, those systems serving >10,000 population with TOC levels still above 4 mg/l would be required to perform bench/pilot studies of technologies capable of achieving levels of less than 2 mg/l. Systems would not be required to implement those technologies. However, EPA would likely use this information in drafting up the potential Phase 2 D/DBP rule. CCWD has experienced TOC levels in the raw source water ranging from 2-9 mg/l with normal levels being in the 3-5 mg/l range. Enhanced coagulation at Bollman would likely remove no more than 20-50% of the TOC. Principal cost impacts for implementation at Bollman would center around increased usage of alum and caustic soda. Usage of these chemicals could essentially double, which would amount up to a $360,000 annual increase. Also, the volume of sludge produced could increase by around 10%, which would mean up to a $ 40,000 annual increase in handling and disposal costs (assuming no new landfill restrictions). Randall Bold cannot implement enhanced coagulation because it is a direct filtration plant. If a Phase 2 D/DBP Rule set an MCL for TOC at 2 mg/l or less it might become necessary for CCWD to install full GAC treatment or membrane technology at both treatment plants. Such technologies represent a 5-10 fold increase over the capital and operating costs associated with conventional treatment.

Giardia, Cryptosporidium, total and fecal coliforms are microorganisms that are sometimes present in the raw source water. EPA has proposed that monitoring be required so data will be available for potential development of an enhanced surface water treatment rule (ESWTR) and/or phase 2 D/DBP rule. CCWD routinely monitors the raw supply for total and fecal coliform and performs limited Giardia and Crytosporidium monitoring. Costs to implement the proposed monitoring are dependent upon how extensive a program is required and could range from $5,000 to $25,000 annually.

Summary of Potential DBP Rule Impacts on CCWD

The D/DBP rule as currently envisioned could require CCWD to do the following by 1997:

1. Implement enhanced coagulation for TOC removal at Bollman. Annual operation costs for chemicals and sludge disposal could increase by around $400,000.

2. Potentially perform bench/pilot scale studies to identify and evaluate advanced technologies capable of reducing TOC levels to below 2 mg/l. One time bench/pilot study costs could range from $30,000 - $300,000.

2. Potentially modify Randall Bold to minimize bromate formation (dependent upon actual MCL established). Costs could range anywhere from $50,000 - $500,000.

3. Add Giardia and Crytosporidium analysis to CCWD's raw water quality monitoring program. Dependent upon extent of program annual costs could range from $5,000 - $25,000.

Future D/DBP Rule impacts to CCWD (after year 2000) could vary from negligible (assumes future health risk information shows phase 2 D/DBP rule is not necessary) to extremely significant (assumes a phase 2 D/DBP Rule with TOC MCL of 1 or 2 mg/l). Capital and operating costs for technologies capable of reducing TOC in delta water to < 2 mg/l are 5-10 times more expensive than conventional water treatment technologies.